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# THE DETECTING CAPACITY CIRCUIT FOR THE BATTERY

## FIELD OF THE INVENTION:

5 The present invention relates to the field of a detecting capacity circuit for the battery, especially with a function that <sup>allows it</sup> to detect the capacity of the battery and <sup>that</sup> it will also be able to cut off the power supply to the electric loop circuit of the drive controlling device <sup>when</sup> automatically while there is a mismatch <sup>on</sup> the polarities, a short circuit or even over-discharged from a battery.

## BACKGROUND OF THE INVENTION:

According to the speedy progress of the modern society, the living standard of the people is improving day by day and the current scientific technology also makes progress at a tremendous pace <sup>leaving more leisure time and increasing the demand</sup> and hence a seeking for convenient <sup>transportation by</sup> traffic.

15 ~~becomes a common objective by everyone accordingly, and the main purpose is to~~ develop all kinds of transportation vehicles such as bicycle, motorcycle, automobile, train, airplane, vessel etc. <sup>For example,</sup> and therefore it is a common situation for the people with personal taste in enjoying leisure time to own at least one or even several luxury cars. With the images of free transportation, comfortable interior decoration, wide-  
20 range of fanciful daydream, <sup>make a</sup> it makes car become an incredible enjoyment in everyone's mind, therefore ~~it is just like~~ a place for taking refuge for the people to run after their favorite models from every kind of media.

Only just the car is the most convenient vehicle in the world, <sup>Whether in the form</sup> in spite of the sedan, wagon..., etc., <sup>of a</sup> a car is <sup>not just</sup> are all the best thing for the travelling, especially in the hot season in case of no hotel room, <sup>vacant</sup> to stay your vehicle <sup>in which case</sup> will then settle the big headache <sup>by serving as a place to sleep</sup> for you accordingly.

Even having all kinds of the benefits from the vehicles, <sup>one</sup> the problem of the car-

owners <sup>is</sup> ~~are~~ that someone might forget <sup>to</sup> turn off the headlights of <sup>the</sup> vehicle ~~often~~, or turn on the stereo equipment, fan, or even high beam for a long period of time, and force the battery to over-discharged ~~and~~ hence have it burn down or ~~out of order~~ <sup>die</sup>.

Furthermore the huge current caused by <sup>a</sup> car accident or short circuit might not only burn down the battery but also caused serious fires etc. <sup>which</sup> ~~all the tragedies like that~~ <sup>could be prevented if there was a</sup> ~~was because there is no any~~ device on the vehicles which <sup>had the</sup> ~~could have~~ a function of auto-cut off. <sup>Solving this</sup> ~~therefore in order to settle the~~ problem of modern people has become <sup>a</sup> very important topic in present-day living.

### SUMMARY OF THE INVENTION:

In light of the above matters and based on ~~the~~ good experience in studying and researching ~~in~~ the field of designing and manufacturing <sup>a</sup> the vehicle's batteries for many years, the inventor <sup>has</sup> ~~thus create~~ the present invention in order to overcome the known problems of the battery, <sup>and so as to</sup> achieve a practical effect at the same time.

Therefore, the preferred purpose of the invention is to provide <sup>Capacity</sup> ~~with a~~ detecting capacity circuit for <sup>a</sup> the battery <sup>that allows detection of</sup> ~~especially with a function that is allowable to detect~~ the capacity of the battery and ~~hence to cut off the power supply at the time while~~ <sup>of</sup> the capacity in battery is either insufficient or overflow.

<sup>According to</sup> And the another preferred purpose of the present invention is to supply a ~~kind~~ of detecting capacity circuit for <sup>a</sup> the battery <sup>that has</sup> ~~with a~~ simple structure and a special function in detecting the capacity ~~display~~ <sup>conditions</sup> under the different loading.

Thus, according to an embodiment of the invention, it is desired to provide a detecting capacity circuit for <sup>a</sup> the battery <sup>that</sup> ~~comprises one set of~~ voltage detecting circuit, ~~one set of~~ current detecting circuit, ~~one set of~~ switching circuit, ~~one set of~~ capacity display circuit, ~~one set of~~ timing circuit and ~~one set of~~ driving circuit etc. <sup>a</sup> ~~and in~~ which are all fixed onto appropriate positions of the battery, <sup>The</sup> ~~therein the~~ current detecting circuit and voltage detecting circuit are installed <sup>in parallel</sup> ~~at the same time~~, and the switching circuit is actually one kind of electronic switch and is installed at

the <sup>a</sup> position between the current detecting circuit and ~~the~~ capacity display circuit, and  
the capacity display circuit comprises more than one set of LED<sup>s</sup> and resistance<sup>s</sup>, the  
the design for the timing circuit is to add and install a timing loop circuit ~~onto~~ <sup>to</sup> the  
voltage detecting circuit, and, furthermore, in the ~~structure of~~ driving circuit, there is  
5 also an extra driving loop circuit which is installed onto the voltage detecting  
circuit.

An embodiment of the present invention will now be described by way of  
example with reference to the accompanying drawings.

## 10 BRIEF DESCRIPTION OF THE ILLUSTRATIONS:

Figure 1 is a sketch-map for the current circuit wiring of the present invention.

Figure 2 is a block diagram of the present invention.

Figure 3 is a flow chart of the present invention.

Figure 4 is a 4051B Truth Table in common use.

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## BRIEF DESCRIPTION OF THE SYMBOLS:

10	Voltage detecting circuit	RL1~RL6	Resistance
	11 Current detecting circuit	R51~R54	Resistance
	12 Switching circuit	R61~R64	Resistance
20	13 Capacity display circuit	R71~R74	Resistance
	14 Timing circuit	R81~R84	Resistance
	15 Driving circuit	R91~R94	Resistance
	16 Manual switch	R101~R104	Resistance
	A01~A10 Operational amplifier	X0	No-loading
25	V01~V10 The input-port of	X1	Light-loading
	Operational amplifier	X3	Heavy-loading
	VC0,VC1 The input-port of	X4	Over-loading

	Operational amplifier	INH	Whether the switching circuit		
	Vref1	Constant voltage	is acting		
	Vref2	Reference voltage	LED1~LED9	Lamp set	
	Z1~Z2	Zener diode	C1*R2	Timing loop circuit	
5	R1~R6	Resistance	A,B,C	4051B	output control
	R01~R02	Resistance	D1~D13	Diode	
	R21~R22	Resistance	I/O 4051B	Input/Output	
	R31~R32	Resistance			
	R41~R42	Resistance			
10	RF	Resistance			

#### DETAILED DESCRIPTION:

Firstly, with reference to both Figures 1 and 2, the present invention which includes <sup>is</sup> a capacity detecting circuit for <sup>a</sup> the battery, <sup>including a</sup> comprises ~~one set of~~ voltage detecting circuit 10, <sup>a</sup> ~~one set of~~ current detecting circuit 11, <sup>a</sup> ~~one set of~~ switching circuit 12, <sup>a</sup> ~~one set of~~ capacity display circuit 13, <sup>a</sup> ~~one set of~~ timing circuit 14, and also <sup>a</sup> ~~one set of~~ driving circuit 15 etc. <sup>and among which:</sup>

By utilizing the ~~enlarging effect from~~ an Operational Amplifier A0, the voltage detecting circuit 10 will <sup>be</sup> ~~analyze~~ <sup>the energy</sup> ~~with the value~~ <sup>by comparing it</sup> output voltage and then <sup>an</sup> ~~it~~ will prohibit the voltage from <sup>being supplied to a</sup> ~~supplying to~~ controlling device if the value of <sup>the</sup> output voltage is lower than the protection voltage, <sup>and which are</sup> according to the following details:

- (1) Resistance R5 and constant voltage diode (Zener diode) Z1 will provide <sup>operating</sup> ~~with a constant voltage Vref1~~ <sup>for a battery connected between terminals</sup>
- (2) Resistance R6 and constant voltage diode (Zener diode) Z2 will provide <sup>a constant reference</sup> ~~with a constant voltage Vref2~~.

(3) When the value of V01 is larger than the value of reference voltage Vref2,

~~it means that~~ the actual voltage of <sup>the</sup> battery is higher than the value of <sup>the</sup> protection voltage so that the <sup>voltage detecting</sup> relative circuit is in normal operating condition. (V01 utilized <sup>S</sup> the voltage divided from both resistance R01 and R02.)

(4) At the time <sup>when</sup> ~~while~~ the value of V01 is smaller than the value of reference

voltage Vref2, ~~it means that~~ the voltage of <sup>the</sup> battery is lower than the value of <sup>the</sup> protection voltage so that it will cut off the loading operation automatically. (V01 utilized <sup>S</sup> the voltage divided from both resistance R01 and R02.)

Furthermore, the current detecting circuit 11 and voltage detecting circuit 10

~~are installed at the same time~~ <sup>in parallel and arranged that when</sup> so it will provide the necessary current signals

~~while~~ <sup>when</sup> the battery is under the condition of checking the <sup>and respective</sup> relative circuit, and

proceeding the operation <sup>with</sup> on constant current controlling procedure, and

<sup>In addition, the two detecting circuits</sup> besides it will utilize the Hall Effect current sensor together with an isolated

function in order to get the necessary current signals without <sup>causing interference between the</sup> interfering the

controlling circuit <sup>and the</sup> with electric power circuit while the said battery is under

a discharging condition. <sup>Assuming that the</sup> ~~Thereby, supposed~~ the value of rated current is 100

ampere <sup>S</sup> and the ratio of the winding coils is 1/1000, and if ~~there is~~ a current of

1 ampere passes through the one time winding coil unit, then ~~in this way it will~~

~~create~~ a current of 0.001 ampere <sup>will appear between the end of the double-wound</sup> at the end of two times winding coil unit.

Moreover <sup>when</sup> ~~while~~ the current passes through a resistance of 100 ohm which is

connected serially to the <sup>double-wound</sup> two times winding coil unit and it will then provide a

<sup>a</sup> voltage of 0.1 volt accordingly; <sup>will be provided. After including the effect of the</sup> after combining with a function of enlarging

<sup>amplification by the</sup> effect which is provided from an Operational Amplifier ( $AF = (R4 + RF) / R4$ ), so

that the current sensor will be able to measure the value of voltage <sup>a</sup> in

corresponding <sup>the</sup> to the value of current and then the current detecting circuit 12

will utilize Operational Amplifier A1 to create a direct current VC1 with <sup>the</sup> same effective value, <sup>which</sup> and then it will be transferred into a current grading circuit for grading and <sup>finer analysis</sup> ~~analyzing further~~ (such as <sup>for</sup> 10 ampere<sup>s</sup>, 20 ampere<sup>s</sup>, 50 ampere<sup>s</sup>...):

1. At the time ~~while~~ the value of current is less than 10 ampere<sup>s</sup>, <sup>then</sup> the Operational Amplifier A2 will output a signal of "-", and Operational Amplifier A3 will output a signal of "-" as well;

2. At the time ~~while~~ the value of current is between 10 ampere<sup>s</sup> and 20 ampere<sup>s</sup>, ~~then~~ the Operational Amplifier A2 will output a signal "+", and Operational Amplifier A3 will output a signal of "-" instead;

3. At the time ~~while~~ the value of current is up to 20 ampere<sup>s</sup>, <sup>then</sup> the Operational Amplifier A2 will output a signal of "+", and Operational Amplifier A3 will output a signal of "+" as well;

4. At the time ~~while~~ the value of current ~~is reach~~<sup>es</sup> 50 ampere<sup>s</sup>, then the Operational Amplifier A4 will output a signal of "-", and hence it will cut off the power supply automatically from the battery to the <sup>load</sup> drive controlling device ~~which is loaded~~.

The switching circuit 12, <sup>in</sup> installed ~~on~~ a position between the current detecting circuit 11 and the capacity display circuit 13 is actually ~~one kind of electronic switch (Multi plexers)~~ <sup>a multiplexer</sup>, in which <sup>which includes</sup> it consists of no-loading X0, light-loading X1, <sup>and</sup> heavy-loading X3 <sup>outputs</sup> together with the corresponding lamp sets of LED7, LED8, LED9, (Please also refer to <sup>of</sup> the Figure 4 the 4051 Truth Table):

1. At the time ~~while~~ the value of current is less than 10 ampere<sup>s</sup>, <sup>input</sup> the A="input", <sup>then</sup> <sup>output</sup> B="no-loading", <sup>and</sup> X0="light-loading", thus LED7 will turn on automatically;

2. At the time ~~while~~ the value of current is between 10 ampere<sup>s</sup> and 20 ampere<sup>s</sup>, <sup>input</sup> the A="light-loading", <sup>input</sup> B="heavy-loading", <sup>then</sup> <sup>output</sup> X1="no-loading", <sup>and</sup> thus LED8 will turn on automatically;

3. At the time <sup>input</sup> while the value of current is between 10 ampere<sup>s</sup> and 50 ampere<sup>s</sup>, <sup>input</sup> the A="+" , B="+" , <sup>output</sup> heavy-loading X3="+" , thus LED9 will turn on automatically;

4. At the time <sup>output</sup> while the signals of no-loading X0, light-loading X1, and heavy-loading X3 are all <sup>output</sup> show "+" , then all the LED7, LED8, LED9 lamp<sup>s</sup> <sup>and</sup> will turn on, <sup>meaning</sup> and it means that the value of current is still within the normal range;

5. At the time <sup>s and</sup> while the value of current is over 50 ampere<sup>s</sup>, the A4 shows "-," it means there is a condition of over-loading <sup>at the output</sup> X4, so that the battery will cut off the power supply for driving the controlling device automatically.

The capacity display circuit comprises more than one <sup>set</sup> ~~set of~~ LED and resistance, and under <sup>set</sup> the different loading conditions, it will <sup>refer to</sup> compare with switching circuit 12 for the status of no-loading X0, light-loading X1 and heavy-loading X3, and <sup>output</sup> ~~then~~ after the value of the voltage in battery has been divided <sup>provide a</sup> it will result in the divided voltage with different impedance to <sup>s</sup> be corresponded to each input port of V05, V06, V07, V08, V09, V10 located on each Operational Amplifier A5, A6, A7, A8, A9, A10 <sup>to provide voltages</sup> accordingly (it means ~~the voltage of V05~V10~~ as follows:

1. At the time <sup>the relevant</sup> while the value of V05 is less than the reference voltage Vref2, ~~then the relative~~ LED1 will turn on a red lamp signal in order to send a message of warning that the capacity in battery is insufficient and <sup>that</sup> thus it will ~~prohibit~~ the discharging operation <sup>will be prohibited</sup> from the battery accordingly;

2. At the time ~~while~~ the value of V05 is larger than the reference voltage Vref2, <sup>to indicate</sup> then the relative LED1 will turn off and it means that the capacity in battery is probably sufficient and thus it will be necessary to observe the status of LED2 in order to confirm whether the battery <sup>is sufficient</sup> is sufficient for the capacity;

3. At the time ~~while~~ the value of V06 is larger than the reference voltage Vref2,

~~then the relative~~ LED2 will turn on a yellow lamp signal in order to indicate a warning that the capacity in <sup>the</sup> battery is on the edge of draining off very soon;

4. At the time ~~while~~ the value of V06 is less than the reference voltage Vref2, ~~then the relative~~ LED2 will not light up any signal, <sup>thereby to indicate</sup> and it means that the battery needs to be charged soon;

5. At the time ~~while~~ the value of V07 is larger than the reference voltage Vref2, ~~then the relative~~ LED3 will turn on a green lamp signal in order to show that the capacity <sup>of the</sup> in battery is sufficient ~~at all~~;

6. At the time ~~while~~ the value of V07 is less than the reference voltage Vref2, ~~then the relative~~ LED3 will not light up, <sup>thereby indicating</sup> any signal and it means that the capacity in <sup>the</sup> battery will drain off soon;

7. Same as the above condition (5), at the time ~~while~~ the value of V08, V09, V10 are all larger than the reference voltage Vref2, ~~then all the relative lamp~~ LED3, LED4, LED5, LED6 will all turn on green lamp signals in order to indicate that the capacity in <sup>the</sup> battery is quite sufficient (The more lamps light up the more sufficient capacity it has);

8. Same as the above condition (6), at the time ~~while~~ the value of V08, V09, V10 are all smaller than the reference voltage Vref2, ~~then all the relative~~ lamps LED3, LED4, LED5, LED6 will not light up any signal, <sup>thereby indicating</sup> and it means that the capacity in <sup>the</sup> battery is insufficient;

In light of the above, it is very easy to <sup>determine</sup> justify whether the capacity in the battery is sufficient just by observing the status of LED1, LED2, LED3, LED4, LED5 and also LED6; and furthermore the capacity display circuit 13 ~~is~~ also <sup>may</sup> allowable to be operated manually in order to observe the capacity of the battery while it is under different loading condition.



The design for timing circuit 14 is to add and install a timing loop circuit C1\*R2 <sup>in</sup> on the voltage detecting circuit 10, <sup>The</sup> ~~therein~~ the timing circuit 14 is installed with the ~~said~~ voltage detecting circuit 10 and current detecting circuit 11 at the same time, <sup>i.e., in parallel & thus when</sup> ~~and hence while there is~~ a voltage V01 <sup>is</sup> input into the system (V01 utilizes the voltage divided from the resistance R01, R02), <sup>R</sup> ~~and if~~

the voltage of the battery is higher than the reference voltage Vref2, ~~it will~~ <sup>The battery will be connected, but when</sup> ~~connect successfully, but on the contrary, while the setting time is over~~ <sup>and</sup>

voltage of the battery is ~~still~~ lower than the reference voltage Vref2, ~~so that the~~ battery will cut off the power supply for driving the controlling device automatically.

1. Similar to the above, in the structure of driving circuit 15 there is also an extra driving loop circuit which is installed <sup>in</sup> ~~onto~~ the voltage detecting circuit 10,

<sup>so that</sup> ~~wherein~~ the driving circuit 15 is installed with the ~~said~~ voltage detecting circuit 10 and current detecting circuit 11 at the same time; and hence <sup>stop</sup> ~~while~~ the voltage of the battery is less than the reference voltage Vref2, ~~thus~~ <sup>automatically</sup> the battery will cut off

the power supply ~~loop~~ circuit for driving the controlling device ~~automatically~~ <sup>when</sup> ~~while~~ the setting time on timing circuit 14 is ~~over or at the time while~~ <sup>equalled or exceeded and</sup>

detecting circuit 11 is detecting the output on A4 <sup>as</sup> ~~is~~ <sup>which</sup> ~~"-"~~ (it means the status of current is abnormal).

In view of the above, preferably all <sup>of the respective</sup> ~~the relative~~ configurations for the circuits installed according to the present invention are fixed properly onto the battery.

Finally, relying on the above structure and with reference to ~~the~~ Figure 3 which is a flow chart for the present invention, ~~in details as followings:~~ <sup>the following functions may be carried out</sup>

1. <sup>according to</sup> ~~with~~ the special functions <sup>start</sup> ~~provided~~ <sup>by</sup> ~~from~~ the present invention, the voltage detecting circuit 10 will detect the battery automatically and try to find out whether the voltage in the battery is <sup>a</sup> ~~in~~ normal condition or not:

(1) At the time ~~when~~ voltage detecting circuit 10 detects <sup>that</sup> ~~with~~ a value of voltage ~~which~~ is much lower than the normal value (or a status of breakdown while it is abnormal), then it will switch into timing circuit 14, and hence stop the power supply at once if it is over the setting time, <sup>or</sup> ~~but~~ it will supply the power accordingly only after <sup>the voltage value</sup> ~~it~~ <sup>a</sup> ~~is~~ revert to normal condition.

(2) At the time ~~while~~ voltage detecting circuit 10 detects ~~with~~ a normal condition, then the current detecting circuit 11 will force the driving circuit 15 to detect the status of current automatically.

2. <sup>When</sup> ~~Supposed~~ it is <sup>has elapsed</sup> ~~over~~ the setting time on the timing circuit 14, the power supply will be stopped at once, and then ~~it~~ will return to voltage detecting circuit 10 system <sup>once</sup> ~~while~~ it has reverted properly.

3. <sup>The</sup> ~~With a function from~~ current detecting circuit 11, ~~it~~ is able to treat the current into different grades such as no-loading ~~X0~~, light-loading ~~X1~~, heavy-loading ~~X3~~ and over-loading ~~X4~~ ~~etc~~, as follows:

(1) <sup>At</sup> ~~At~~ the time ~~while~~ the status of the current is overflow, <sup>the current detecting circuit</sup> ~~it~~ will be able to test automatically whether it is allowable to supply the power again, ~~but instead it~~ will switch into the timing circuit 14 if it has determined that it is still not suitable, and also ~~it~~ will stop supplying the power <sup>when</sup> ~~while~~ it is over the setting time, <sup>when</sup> ~~but it~~ will supply the power again <sup>a</sup> ~~while~~ it has reverted properly.

(2) At the time ~~while~~ everything is in normal status, then the current detecting circuit 11 will drive capacity display circuit 13 by means of switching circuit

13.

4. <sup>possible</sup> ~~it is available~~ to find out whether the capacity in the battery is sufficient or not in order to supply the power just by means of the capacity display circuit 13.

*above-described*  
Preferably, with the special function ~~form~~ the present invention of ~~detecting~~  
~~capacity circuit for the battery, it is allowable to detect~~ the exact capacity in the

battery, and hence it is very easy for the user to find out whether the capacity in

5 the battery is sufficient or not. Furthermore, *the invention* it will isolate both the battery and

*load when* loading properly *polarity* while it is mismatched in the polarities, in a condition of short

circuit, or even *when the* while it is over-discharged from a battery *is discharging excessively*

~~In view of the specific embodiment described herein,~~ *a* While particular

10 embodiment of the present invention has been illustrated and described, it would be  
obvious to those skilled in the art that various other changes and modifications can  
be made without departing from the spirit and scope of the invention. It is therefore  
intended to cover in the appended claims all such changes and modifications that  
are within the scope of the present invention.

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**ABSTRACT:**

A detecting capacity circuit for the battery which comprises one set of voltage detecting circuit, one set of current detecting circuit, one set of switching circuit, one set of capacity display circuit, one set of timing circuit and one set of driving  
5 circuit etc.; among which, the above circuits are all fixed on the appropriate positions of the battery, and under the multiple-loaded circumstances if the battery do have the special functions of present invention it will not only be allowable to detect it's capacity but also be able to properly isolate both the battery and the  
10 loading while there is a mismatch on the polarities, a short circuit, or even over-discharged from a battery.

Figure 1

Figure 2

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Battery Voltage detecting circuit Capacity display circuit Driving  
circuit  
Current detecting circuit Timing circuit  
10 Switching circuit

Figure 3

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Starting

Voltage detecting circuit detecting on the low voltage  
Driving circuit  
Current detecting circuit the current is overflow  
20 Timing circuit

to grade the current the setting time is over  
Switching circuit

Capacity display circuit insufficient voltage  
25 stop power supply

Continue to supply the power revert